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Biological Evaluation of Forest Insect Conditions in Zion National Park 1969

This report was compiled from information collected during two biological surveys conducted in August and December of 1969. Entomologist Larry Stipe and Forestry Technician Otto Sandin conducted the first survey, and Entomologists Douglas Parker and Larry Stipe conducted the second survey. Background material for this report was also obtained from past biological evaluations and reports.

Briefly, two insects caused concern in 1969. Activity of a tent caterpillar, Malacosoma incurvum discoloratum (Neumoegen) caused light defoliation to the Fremont cottonwood, Populus fremontii S. Wats. in the Park. As has been the case for several years, a microbial insecticide Bacillus thuringiensis var. thuringiensis (Berliner) (Thuricide 90TS) was used to further suppress the already low tent caterpillar population. This control, coupled with natural biological limiting factors, suppressed the population. The second insect causing concern was a blotch miner (Phyllonorycter sp.). This microlepidoptera caused premature defoliation of Fremont cottonwood in the Park and also along the Virgin River south of the Park. A more detailed discussion of each problem follows:

A tent caterpillar, Malacosoma incurvum discoloratum (Neumoegen)

History. In 1965, heavy defoliation of the Fremont cottonwood in the Park resulted from tent caterpillar activity. This damage presented a considerable esthetic problem. Due to control measures and natural factors, a decreasing trend has been in progress since 1965.

Methods. Egg mass density counts are used to predict the following year's damage caused by the tent caterpillar. The egg mass survey is conducted in the fall after the moths have flown, mated, and deposited their eggs. Entomologists from our office have found, from studies conducted several years ago in Zion National Park, that 90 percent of the eggs are located on the distal 30 inches of branches in the midcrown of Fremont cottonwood. Using this information in connection with an evaluation system developed at the Forest Insect Laboratory in Albuquerque, New Mexico, a prediction of the following year's damage can be made. Egg mass counts are averaged for two 30-inch branches per tree from all of the trees sampled in each area. Egg mass counts as related to defoliation classes are shown in the following table:

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Average Number New Egg Masses	
Per two 30-inch branches	Predicted defoliation
0.1 to 0.7	light
1.2 to 1.7	moderate
2.5 to more	heavy

Normally 20 trees are sampled in each area; however, because of the light defoliation in 1969 only 10 trees per area were sampled. Four 30-inch branches were cut from each tree and the number of egg masses on each branch was counted. The average number of egg masses for two 30-inch branches per tree per area was obtained by dividing the total number of egg masses per area by two, and then dividing this number by 10. A prediction of future defoliation was obtained by comparing this number to the above table.

Results and Discussion. The use of B. thuringiensis (B.t.) played a major role in reducing the tent caterpillar activity. However, natural factors such as weather, predation, and parasitism have most probably contributed to the decline.

To gain information on the future status of the tent caterpillar population, samples were collected in areas where, according to Park Ranger Fred Brueck, activity occurred last spring and summer. They are as follows:

Area	Location in Park
1	South Campground (west side)
2	South Campground (east side)
3	Ranger Home Group (Oak Creek)
4	At fork of road to Zion Lodge
5	Zion Lodge Area

A resume of our data follows:

Area	Total No. Egg Masses	Average No. of Egg Masses Per Two 30-Inch Branches	Expected 1970 Defoliation
1	0	none	none
2	2	.1	light
3	1	.05	very light
4	1	.05	very light
5	1	.05	very light

These data indicate that the damage to the cottonwoods in the areas sampled will be mostly very light. We expect the same to be true of all other areas in the Park. Additionally, the insect population level should be at a lower level in 1970 than in 1969.

Recommendation. Control should not be necessary to preserve the esthetic appearance of the Fremont cottonwood. However, if there is an ample supply of B.t. available, nothing can be lost by spraying the tent caterpillar colonies as they appear. This would further suppress the already low population.

A blotch miner, (Phyllonorycter sp.).

History. Little is known about the past activity of this insect in the Park. Ranger Fred Brueck has observed varying degrees of defoliation caused by this insect for the past several years, but damage appeared to be heavier this year.

Methods. Foliage with blotch miner damage was observed at all locations in the Park where Fremont cottonwood is found. Offhand, it appeared that some areas were harder hit than others. As a check of this suspected variation, two areas were selected for sampling--Watchman Campground and Zion Lodge.

Samples of the leaves were collected in December after they had fallen from the trees. Four bags of leaves were collected at both sites. In the laboratory, 25 leaves were systematically selected from each of the four bags. This made a total of 100 leaves checked in each area. Leaves were inspected for the characteristic damage. By checking the number of leaves damaged out of the possible 100, a percentage of the infested leaves could be estimated. The number of blotches per leaf was also recorded to gain further insight into the insect population level. Additionally, parasite pupae were found in many of the mines and these were recorded to check the incidence of parasitism.

One bag of soil was collected at both Watchman Campground and Zion Lodge to check whether the blotch miner overwintered as pupae in the ground.

Results and Discussion. In October, 1968, Entomologist Bruce Baker observed blotch miner moths in flight. He collected several specimens and these were sent to an authority for positive identification. We have not received this determination as of yet, but we will inform you when we receive the determination. From the descriptions found in Keen 1/, we believe that Phyllonorycter tremuloidella Braun* is the pest species, but we cannot be positive of this determination.

1/ Keen, F.P. 1952. The Insect Enemies of Western Forests. Dept. Agr. Misc. Pub. 237, 280 pp.

* Later identified as Lithocolletis sp. near salicivovella Braun by D. R. Davis.

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We cannot provide you with much information on the biology of this insect. We did not find any pupae in the leaf mines or in the soil samples that were collected. Bruce Baker observed moths in flight fairly late in the fall; and, for this reason, we believe that the adults mate and lay their eggs in the fall. The eggs, therefore, appear to be the overwintering stage. Generally, we believe that the eggs hatch after the leaves have appeared in the spring and have developed to some degree. The larvae then attack the leaves and mine out the circular blotches. The damage results in premature defoliation in late July or early August. Apparently, the adults emerge from the leaves after they have fallen. They lay their eggs at an undetermined location and the cycle begins again.

Damage to individual leaves was in the form of circular to oval shaped mines. The circular mines were approximately $\frac{1}{4}$ to $\frac{1}{2}$-inch in diameter, and the oval mines were approximately $\frac{1}{4}$-inch wide and 3/4-inch long (Fig. 1). The mines were found on both the upper and lower surfaces of the leaves.

From observations made in August, the lower portions of the tree crowns appeared to be more heavily attacked than the upper portions (Fig. 2). This characteristic activity occurred on both large and small trees.

A portion of the severely damaged leaves started falling from the trees in late July and this activity continued in August (Fig. 3). It is not known what extent of damage is necessary to cause defoliation, but 3-4 mines per leaf may be sufficient.

Premature defoliation should not cause concernful damage to the trees. This tree is a hearty species that is capable of refoliation; besides, some photosynthetic activity occurs before the leaves are lost. The cottonwoods would probably have to be heavily defoliated for several consecutive years before significant damage would start appearing.

A summary of the data collected from the leaf samples to check variation in damage follows:

Area	Percent Leaves Infested	Range of No. Blotches Per Leaf	Mean No. Blotches Per Leaf	Mean No. Parasites Per Leaf
Watchman Campground	79	0-36	3.6	0.7
Zion Lodge	94	0-18	5.3	0.4

These data indicate that the infestation was heavier near Zion Lodge than around Watchman Campground. The percent of leaves infested was

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Figure 1. Fremont cottonwood leaf with poplar leaf blotch miner damage (Zion National Park, 1969).

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Figure 2. Poplar leaf blotch miner activity appeared to be heavier in the lower portions of the crown in Fremont cottonwood (Zion National Park, 1969).

Figure 3. Premature defoliation of Fremont cottonwood occurred in early August as a result of poplar leaf blotch miner damage (Zion National Park, August 13, 1969).

higher, and the mean number of blotches per leaf was higher. The population at both locations, however, appears to be substantial.

The incidence of parasitism, as is shown in the above table, is not high. However, many parasite pupae were found in the soil samples as well as those that were found in the leaves (Fig. 4). This would indicate that the parasite population is building and could contribute to a reduction in the blotch miner population in 1970.

We do not have a great deal of information to indicate the intensity of damage for 1970. We hope to get two of our entomologists to the Park early next spring, and they may be able to make an estimate of the forthcoming damage at that time.

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Figure 4. Parasite pupae found in the mine of a poplar leaf blotch miner (Zion National Park, 1969).